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RESEARCH AND DEVELOPMENT TECHNICAL REPORT  
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ELECTROMAGNETIC RADIATION SYSTEM (EMRS)  
FOR SUSCEPTIBILITY TESTING

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LAEL Service Corp.

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Quarterly Report for Period 1 July 1978 - 30 September 1978

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The function of the Electromagnetic Radiation System (EMRS) is to generate electromagnetic energy so as to produce a constant field strength that can be automatically scanned as a function of frequency. The design objective is to cover the frequency range of 30 hertz to 40 gigahertz with field strength intensities up to 200 volts per meter. This report describes system equip- ment status and results of performance tests, particularly in the 30 MHz to 60 MHz frequency range. ←		

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## **I. INTRODUCTION.**

This report describes the activities and developments concerning Phase II of the Electromagnetic Radiation System (EMRS) Program during the period of 1 July 1978 through 30 September 1978. The purpose of Phase II of the EMRS program is to develop the hardware to demonstrate the feasibility of the theoretical design considered in Phase I.

## 11. STATUS OF EMRS EQUIPMENT.

All major equipment comprising the EMRS demonstration system has been received, with the exception of the following:

### 1. Tunable bandpass filters:

The tunable bandpass filters, for the 30 MHz to 60 MHz, 1 GHz to 2.1 GHz, 2.1 GHz to 4 GHz, and 12.4 GHz to 18 GHz frequency ranges, are on order. The most recent estimate of delivery is January 1979.

### 2. Logimetrics A200U amplifier for 12.4 GHz to 18 GHz range:

This amplifier was returned to the manufacturer for repair. It is expected that the repaired item will be returned to AEL during October 1978.

### III. PROGRESS DURING REPORT PERIOD

During this period, all of the EMRS equipment, which had been received, was thoroughly checked to make certain that it complied with manufacturers' specifications. This checkout included measurement of spurious and harmonic emission, where applicable. The equipment met applicable requirements.

The EMRS system was then assembled. All cable harnesses were made up and completely checked out. Modifications were made to the signal entrance panel on the shielded enclosure in which the EMRS radiating elements were to be installed. These modifications consisted of installing waveguide and coaxial feedthrough connectors to accommodate waveguide and coaxial lines between the EMRS radiating elements and other equipment inside the enclosure, and signal generation and monitoring equipment outside the enclosure. The entire assembled system was then checked for compatibility and performance. Results indicated that the assembly techniques were correct.

An extensive checkout of the entire EMRS system, including radiating and monitoring elements, was then performed to determine compatibility between the electronic equipment and the radiating elements. Results were satisfactory.

Tests were then performed, in accordance with the EMRS Test Plan dated July 1978, on the 30 MHz - 60 MHz portion of the EMRS system. Results are summarized in Table 1. Some of the tests were witnessed by a representative of U.S. Army CORADCOM, during a visit to AEL on 29 September 1978.

Table 1 shows that the 30 MHz - 60 MHz EMRS demonstration system met all requirements specified in the test plan for the following tests: Frequency Accuracy, External FM, External AM, High-Level (200 volts per meter) Radiated Output and Level Variation, Non-Radiated Output and Level Variation. It did not meet all requirements for External Pulse Modulation and Low-Level (1 millivolt per meter) Radiated Output and Level Variation. Tests for Scan Rate and Signal



Purity were not performed because they require the tunable filters mentioned in Section II.

Work is in progress to improve performance of the AEL-built pulse modulation circuit, and to determine performance limitations inherent in the design. The goal of this work is to meet the external pulse modulation requirements outlined in the test plan. These design goals are as follows:

Rise Time and Fall Time: 50 nanoseconds each

Pulse Widths: 50 nanoseconds to 50 milliseconds

Repetition Rates: 100 Hz to 10 MHz

Work is also in progress to increase the dynamic range of the EMRS system from the present 50 dB (below 200 volts per meter) to the design goal of 106 dB (down to a minimum of 1 millivolt per meter), where practical from a cost-effectiveness standpoint. The present approach, as discussed with the CORADCOM representative, is to utilize laboratory amplifiers available at AEL to increase the level of the sampled radiated signal to the amplitude required to perform the leveling function of the EMRS system.

During this period, preliminary testing of the 1 GHz to 2.1 GHz portion of the EMRS demonstration system to test plan requirements was also performed. The preliminary results were similar to those obtained with the 30 MHz to 60 MHz demonstration system.

#### IV. FUTURE PLANS.

During the next reporting period, the following activities are anticipated:

1. Receipt of repaired amplifier for 12.4 to 18 GHz range.
2. Performance of EMI tests, in accordance with the EMRS Test Plan dated July 1978, on 1-2.1 GHz, 2.1-4 GHz and 12.4-18 GHz demonstration systems, to the degree possible without the tunable bandpass filters mentioned in Section II.
3. Completion of design and assembly work on the pulse modulation circuit, and tests to determine its characteristics and capabilities.
4. Completion of experimental work to increase the dynamic range of the EMRS system, using existing laboratory amplifiers available at AEL.

TABLE 1

## SUMMARY OF EMRS TEST RESULTS, 30-60 MHZ FREQUENCY BAND

<u>TEST PLAN PARA.</u>	<u>TEST DESCRIPTION</u>	<u>STATUS AND RESULTS</u>
5.1.2	Frequency Accuracy	Meets requirements.
5.1.3	Scan Rate	Awaiting filter delivery.
5.1.4	Modulation:	
	External FM	Meets requirements.
	External AM	Meets requirements.
	External Pulse	Requires further work.
5.1.5	Radiated Output and Level Variation:	
	Low (1 mV/M)	Requires further work.
	High (200 V/M)	Meets requirements.
5.1.6	Non-Radiated Output and Level Variation	Meets requirements.
5.1.7	Signal Purity	Awaiting filter delivery.